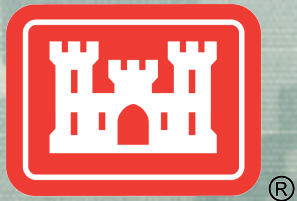


Tainter Gate Cleanout, Newburgh L&D

Louisville District, Ohio River

Kevin Vessels

10 February 2015



Newburgh Tainter Gate, 110' wide X 35' tall



Mud and Debris in the Tainter Gate



More mud and debris in a tainter gate



Most of the debris, especially the larger debris entered the tainter gate body prior to early 2,000.

In early 2,000 a contractor re-plated the missing and damaged tainter gate plates and side shields.

The sides of the tainter gate against the concrete piers are open and can allow smaller debris to enter the tainter gate body.

Gate	Mud Volume	Saturated Weight
	(ft ³)	(kip)
1	920	97
2	2889	303
3	2810	295
4	3672	386
5	3358	353
6	3672	386
7	2080	218
8	115	12
9	5397	567

Table 1. Estimated weight of mud and debris in Newburgh tainter gates.

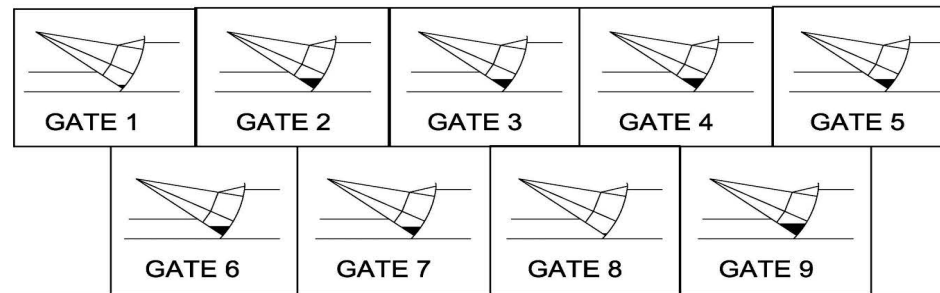


Figure 1. Graphical representation of level of mud in gates. Mud is dark shaded area in bottom of the gate body.

567 kip of mud added to the 788 kip gate results in a total weight of approximately 1355 kip. The listed capacity of each hoist is 425 tons. The two hoists combine to provide a total listed capacity of 1700 kip per gate. The listed capacity of the hoist is not indicative of the capacity of every component of the mechanical system, and does not necessarily make allowance for the required factors of safety.

The methodology employed in the structural analysis was to create a finite element model of the entire tainter gate in RAM Elements. Three different positions were considered, but only two analyzed to capture the behavior of the gate through its full range of operation:

- Position 1: Gate barely lifted off the sill with full hydrostatic loading
- Position 2: Gate half open with partial hydrostatic loading; by inspection will not control
- Position 3: Gate barely lifted out of the water

Member	Demand/Capacity Ratio		% Increase Due to Mud
	Without Mud	With Mud	
Ribs, internal	0.14	0.42	200%
Top Level, bracing	0.04	0.05	25%
Middle level, DS Face diagonals	0.29	0.56	93%
Middle level, DS Face verticals	0.05	0.04	-20%
Middle level, Internal diagonals	0.10	0.18	80%
Lower level, DS face verticals	0.01	0.17	1600%
Lower level, DS face diagonals	0.14	0.32	129%
Lower level, internal diagonals	0.03	0.07	133%
Strut arms	0.08	0.11	4%

Table 4: Position 3: Gate out of water, saturated weight of mud

The results of the mechanical analysis are summarized in Table 5, below.

Component	Factor of Safety	
	Without mud	With mud
Drum gear	5.17	3.42
Drum shaft	5.02	4.02
Cable	4.59	3.05

Table 5: Mechanical components factors of safety

EM 1110-2-2610, Mechanical and Electrical Design for Lock and Dam Operating Equipment, section 2-1.b requires that all components of the operating equipment be designed for normal operating loads with a minimum factor of safety of 5.0, based on the ultimate tensile strength of the material. Therefore, this analysis shows that the machinery is beyond the design limits when the mud load becomes part of the normal operating loads. However, with the lowest factor of safety being 3.05, the machinery is not in imminent danger of failure.

All mechanical components are also designed such that they do not exceed 75% of the yield strength of the material at the stall torque of the motor. This means that the motor will kick out before any of the other components fail. The mud weight does diminish the reserve capacity of the mechanical system such that its ability to handle additional unusual loads is reduced. Additional unusual loads that may occur include additional mud, ice weight, the failure of one of the hoists, and higher than expected friction forces.

Electrical engineers determined that the mud and debris is not a threat to the gates' electrical systems. During the 2012 periodic inspection, all tainter gates were operated while taking electrical measurements. All values were within rated values and the gates functioned without incident. Therefore, there is no need for further analysis of the electrical system.

The lock crew started on gate nine. It had the most mud load and is the end gate on the KY side.

They removed 3 of the downstream skin sheets for access.

They remove by hand the large debris and washed clean one gate pan area, then they enlarged the 3" drain holes to about 10".

Next they removed large debris by hand and washed all the mud from the adjacent gate pan to the one they just cleaned with the enlarged 10" drain holes.

They then enlarged the 3" drain hole in the next gate pan and repeated the process.

Gate nine took 3 weeks to remove the mud and debris and re-install the three skin sheets.





They moved to gate 6 next. It had bad wire ropes on it and the Louisville Repair Station was going to change out the wire rope and cable connections later in season.

Gate six had the second highest amount of mud and debris in it.

They only removed two downstream skin sheets on gate 6.

It took two weeks to remove the mud, debris and replace the two skin sheets.

Next they went to gate 8, it took about 7 days.

Grating was installed inside the tainter gates over the 10" drain holes they made.

In 2015 they plan on finishing the other 6 gates.

After



One reason the mud and debris needed to be removed is to be able to replace the wire ropes and the cable connection blocks on the tainter gates.



Tainter Gate Pedestals

Old style on the right have a 415 kip capacity each.

New Style on the left have a 590 kip capacity each.

If you remember from the previous slide, gate 9 weighed 677 kips each side.



Old style tainter gate pedestals set and ready for use.



Questions?

FLOATING MOORING BITT POST FAILURES

Typical upper structure of the mooring bits on the Ohio River.



The top of this bit flew across the 110' chamber and landed on the 3rd barge over.



We decided to look at all the bitts in use.

During inspection of the bitts I found a post that had tore off and been repaired sometime in the past.



Cracked fillet weld, note both fillet weld edges touch each other.



Crack leaving the edge of one fillet weld and propagating across towards the other



You might want to check your mooring bit posts.

Questions?